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Original research article

Butterflies (Lepidoptera: Papilionoidea) of Mount Sago, West Sumatra: Diversity and Flower Preference

Ratih Rusman,¹ Tri Atmowidi,^{1*} Djunijanti Peggie²¹ Department of Biology, Faculty of Mathematics and Natural Sciences, Bogor Agricultural University, Bogor, Indonesia.² Zoology Division (Museum Zoologicum Bogoriense), Research Center for Biology-LIPI, Cibinong, Indonesia.

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ABSTRACT

Diversity of butterfly depends on the availability of food plant and habitat quality. The aims of this study were to assess diversity and flower preference of butterflies in Mount Sago, West Sumatra, Indonesia. Observations were performed by scan sampling method in four types of habitats, i.e. secondary forests, pine forests, rubber forests, and agricultural areas. Our results showed that at least 184 species of butterflies and 56 species of nectar plants have been identified in Mount Sago. Nymphalid butterfly, *Neptis hylas*, was the most dominant species of butterflies. Two species, i.e. *Trogonoptera brookiana* and *Troides amphrysus*, were found as the protected butterflies. Diversity of butterfly in secondary forests was highest, whereas the lowest diversity was found in pine forest. Papilionid butterflies were found frequently feeding on tube blossoms, nymphalid butterflies on head blossoms, and lycaenid butterflies on flag blossom. Our results also showed that habitat change impacts composition and diversity of butterfly.

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1. Introduction

Butterflies (Lepidoptera: Papilionoidea) are holometabolous insects and their survival depends on the availability of food plant for caterpillar (Dahelmi 2000) and adult (Meviuschutz and Erhardt 2005). Most of adult butterflies are nectar feeder and the others also feed on pollen (Hikl and Krenn 2011), moist soil, mud, carrion (Sculley and Boggs 1996), and fruits (Ramos 2000). Some species of butterflies are generalists in choosing plants as nectar sources and the others are specialists (Tudor et al. 2004). Food preferences of butterflies is influenced by flower characteristics, such as shape, length, color and nectar and characteristic of butterflies, such as proboscis length, wing load indices (Tiple et al. 2009), visual and olfactory (Fahem et al. 2004).

Butterflies play important role in the forest ecosystems. They provide the stability in the food webs, as herbivore (Dahelmi 2000), pollinator (Atmowidi et al. 2007), host of parasitoids, and prey of predators (Hammond and Miller 1998). Many of butterfly species function as indicator in the ecologic changes (Posha and Sodhi 2006; Koh 2007; Hill 1999). Diversity of butterfly in Indonesia

has been recorded. In Slamet mountain, Central Java, species richness of butterfly consists of 62 species in secondary forest, 64 species in plantation forest, 47 species in recreation forest, and 38 species in agroforest (Widhiono 2004). Furthermore, species richness of butterfly in urban forest of Muhammad Sabki, Jambi, consists of 37 species in rubber forest, 37 species in stream side, 33 species in the park, and 27 species in mixed forest (Rahayu and Basukiriadi 2012). Here, we studied diversity and flower preference of butterfly in tropical secondary rainforest and in the three types of land use in Mount Sago, West Sumatra.

Mount Sago is one of the tropical rainforests in Tanah Datar and Limapuluh Kota districts, West Sumatra. Generally, Mount Sago is dominated by secondary forests. The forest area had been degraded because of commercial logging or anthropogenic land use, such as for settlements and agricultural plantations. The disturbances have impact on the balance of ecosystems and decline in biodiversity (Barnes et al. 2014). Since 22 August 1982, most areas of Mount Sago were established as a Nature Reserve. Data on the diversity of flora and fauna in those areas are necessary to support conservation in Mount Sago.

* Corresponding author.

E-mail address: atmowidi@gmail.com (T. Atmowidi).

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2. Materials and Methods

2.1. Collection, preservation, and identification of butterflies

This research was conducted in Mount Sago Nature Reserve, West Sumatra, Indonesia, and its adjacent habitats, in September to November 2013. The study area covered two subdistricts, i.e. Luak and Lareh Sago Halaban. Butterflies were surveyed in four types of habitats, i.e. secondary forests, pine forests, rubber forests, and agricultural areas. Each habitat was observed for 10 days by using scan sampling method along the survey tracks, every 45 min/hr, from 08:00 AM to 04:00 PM. Observations included the number of species and individual butterflies. Butterflies were collected by insect net and were subsequently kept in a triangular paper envelope. The collected specimens then were brought to Entomology Laboratory of Museum Zoologicum Bogoriense (MZB)-LIPI and Division of Animal Biosystematics and Ecology, Bogor Agricultural University for mounting and identification. Butterfly specimens were identified based on Morishita (1981), Yata (1981), Aoki *et al.* (1982), Tsukada and Nishiyama (1982), and Tsukada (1991).

2.2. Observation of flower preferences by butterfly

Species of butterflies visited flowers were observed. Nectar plants visited by species of butterfly were identified and described, i.e. habits, colors, and flower types. The plants species were verified by Dr Nurainas (Botanist at Herbarium of Andalas University, Indonesia).

2.3. Data analysis

Data of individual and species number of butterflies were summarized. Nectar plants and flower preference of butterflies were described. Diversity of butterflies were analyzed using the Shannon–Wiener diversity index (H') and Pielou evenness index (E).

3. Results

3.1. Diversity of butterfly

In Mount Sago, we collected 3058 individuals of butterflies that belong to 184 species and five families. Secondary forests, rubber forest, and agricultural area showed high species richness of butterfly, which were 112, 95, and 94 species, respectively. Twenty-two species of butterflies were found in all four habitat types. Butterfly species found only in secondary forest, pine forest, rubber forest, and agricultural area were 26, 4, 37, and 18 species, respectively. Nymphalid butterfly showed the highest diversity (93 species, 1564 individuals), whereas Riodinid butterfly showed the lowest number (three species, three individuals). The most abundant species in secondary forest, pine forest, rubber forest, and agricultural areas were *Faunis canens* (31 individuals), *Papilio polytes* (52 individuals), *Junonia atlites* (81 individuals), and *Neptis hylas* (77 individuals), respectively. Diversity of butterfly in secondary forests was highest ($H' = 4.095$, $E = 0.884$), followed by rubber forests ($H' = 4.007$, $E = 0.837$), agricultural area ($H' = 3.785$, $E = 0.822$), and pine forests ($H' = 3.418$, $E = 0.822$; Table 1).

3.2. Flower preference of butterflies

According to the observations, butterflies visit a wide range of available flowers. A total of 56 plants species belonging to 25 families were visited by at least 51 species of butterflies belonging to four families. Some species of plants visited by butterfly were cultivated crops, such as *Persea americana*, *Cinnamomum zeylanicum*, *Momordica charantia*, *Hibiscus sabdariffa*, *Eugenia aquea*, and *Psidium guajava*. Butterflies preferred to feed on flower nectar of shrubs than herbs, trees, or lianas. They visited flowers with white, red, pink, orange, yellow, purple, and blue color. Head and tube blossoms, such as florets of Asteraceae and Verbenaceae, were the

Table 1. List of butterfly species found at four types of habitats in Mount Sago

Family and species	Number of individuals				Total
	Secondary forests	Pine forests	Rubber forests	Agricultural areas	
Lycaenidae					
<i>Allotinus leogoron</i>				4	4
<i>Amblypodia narada</i>			1		1
<i>Ancema blanka</i>			2		2
<i>Anthene lycaenina</i>	1				1
<i>Arhopala brooksiana</i>			1		1
<i>Arhopala buddha</i>	1				1
<i>Arhopala eomolpus</i>				1	1
<i>Arhopala inornata</i>	1				1
<i>Arhopala kinabala</i>				1	1
<i>Arhopala lurida</i>	1				1
<i>Arhopala pseudocentaurus</i>			1		1
<i>Arhopala zylde</i>		1			1
<i>Arhopala</i> sp.			8		8
<i>Caleta elna</i>			2		2
<i>Celastrina lavendularis</i>	6				6
<i>Curetis santana</i>			2		2
<i>Curetis tagalica</i>	1		1		2
<i>Discolampa ethion</i>			2		2
<i>Drupadia rufotaenia</i>		1	1		2
<i>Drupadia theda</i>			3		3
<i>Euchrysops cnejus</i>	2	3			5
<i>Everes lacturnus</i>		41			41
<i>Ionolyce helicon</i>	1				1
<i>Jamides caeruleus</i>	2				2
<i>Jamides celeno</i>	2	9	6	13	30
<i>Jamides malaccana</i>			4	3	7
<i>Jamides pura</i>	5	8	7	3	23
<i>Jamides</i> sp.	7	50	50	29	136
<i>Lampides boeticus</i>		12	2	13	27
<i>Manto hypoleuca</i>			2		2
<i>Megisba malaya</i>				2	2
<i>Miletus bigsii</i>	5	10		1	16
<i>Miletus bolsduvali</i>	2			5	7
<i>Miletus gallus</i>	1				1
<i>Nacaduba beroe</i>				1	1
<i>Neopithecops zalmora</i>				2	2
<i>Petralaea dana</i>	1				1
<i>Pithecops corvus</i>	11		2		13
<i>Pithecops fulgens</i>	5				5
<i>Prosotas nora</i>	16			3	19
<i>Remelana jangala</i>			1		1
<i>Rapala iarbus</i>	1	5		2	8
<i>Rapala manea</i>	1				1
<i>Rapala pheretima</i>	1				1
<i>Sinthusia malika</i>	1		1		2
<i>Udara camenae</i>	3	1			4
<i>Udara dilecta</i>	23			1	24
<i>Udara</i> sp.	23				23
<i>Una usta</i>	3				3
<i>Yasoda pita</i>				1	1
<i>Zizina Otis</i>	1	1		2	4
Nymphalidae					
<i>Acraea terpsicore</i>		2	1	4	7
<i>Amathusia binghami</i>			2		2
<i>Amnosia decora</i>	5				5
<i>Argyreus hyperbius</i>	2	2	1	8	13
<i>Ariadne Ariadne</i>		1	2		3
<i>Ariadne merione</i>				1	1
<i>Athyma reta</i>			2		2
<i>Athyma nefte</i>			1		1
<i>Athyma perius</i>		1			1
<i>Charaxes bernardus</i>			1		1
<i>Charaxes borneensis</i>			1		1
<i>Charaxes (Polyura) athamas</i>		2	5		7
<i>Charaxes (Polyura) hebe</i>			1		1
<i>Chersonesia risa</i>	19			3	22
<i>Cupha erymanthis</i>	1		18		19
<i>Cyrestis maenalis</i>	2			1	3
<i>Danaus genutia</i>			1	2	3
<i>Danaus melanippus</i>		44	49	1	94
<i>Dichorragia nesimachus</i>			1		1

(continued on next page)

Table 1 (continued)

Family and species	Number of individuals				Total
	Secondary forests	Pine forests	Rubber forests	Agricultural areas	
<i>Discophora necho</i>				1	1
<i>Doleschallia bisaltide</i>			4	9	13
<i>Elymnias nesaea</i>		1	4	1	6
<i>Elymnias panthera</i>		3	7	3	13
<i>Euploea algae</i>	1				1
<i>Euploea camaralzeman</i>	2		3		5
<i>Euploea eunice</i>	2		1	1	4
<i>Euploea mulciber</i>	6		14	4	24
<i>Euploea radamanthus</i>			1		1
<i>Euploea sp.</i>	3		18	2	23
<i>Euploea tulliolus</i>	3	1	31	17	52
<i>Euripus nyctelius</i>				1	1
<i>Euthalia aconthea</i>				4	4
<i>Euthalia kanda</i>				1	1
<i>Euthalia monina</i>		2		3	5
<i>Euthalia sp.</i>	1	2	4	2	9
<i>Faunis canens</i>	31			2	33
<i>Hestinalis nama</i>			4		4
<i>Hypolimnas bolina</i>	1	1	16	55	73
<i>Hypolimnas misippus</i>		1		2	3
<i>Ideopsis gaura</i>			2		2
<i>Junonia almana</i>		7	28	19	54
<i>Junonia atlites</i>	2	31	81	34	148
<i>Junonia hedonia</i>		10	10	43	63
<i>Junonia iphita</i>	1	2	41	20	64
<i>Junonia orithya</i>	1	1	1	4	7
<i>Laringa castelnaui</i>				1	1
<i>Laringa horsfieldi</i>	1		2		3
<i>Lethe chandica</i>	1			13	14
<i>Lethe confuse</i>	7			1	8
<i>Lethe europa</i>				3	3
<i>Lethe makara</i>			1		1
<i>Lexias dirtea</i>	3				3
<i>Melanitis leda</i>		1	4	5	10
<i>Melanitis phedima</i>		4	5	7	16
<i>Melanitis zitenius</i>	6				6
<i>Moduza procris</i>			1		1
<i>Mycalesis horsfieldi</i>	2	1	1	4	8
<i>Mycalesis janardana</i>	4		9	4	17
<i>Mycalesis marginata</i>	3				3
<i>Mycalesis mineus</i>	2	3	1	3	9
<i>Mycalesis mnasicles</i>			3	15	18
<i>Mycalesis oroatis</i>	9				9
<i>Mycalesis orseis</i>	7	1	2	2	12
<i>Mycalesis perseus</i>		1		1	2
<i>Mycalesis sp.</i>	1	27	29	59	116
<i>Neorina lowii</i>			2		2
<i>Neptis clinia</i>				1	1
<i>Neptis clinioides</i>	1				1
<i>Neptis duryodana</i>	2		1		3
<i>Neptis harita</i>			1		1
<i>Neptis hylas</i>	8	34	37	77	156
<i>Neptis ilira</i>			1		1
<i>Neptis nata</i>			1		1
<i>Neptis vikasi</i>			2		2
<i>Orsotriaena medus</i>	1	3	4	4	12
<i>Parantica agleoides</i>	3	2	3		8
<i>Parantica aspasia</i>	2	1	13	1	17
<i>Parantica pseudomelaneus</i>	2			1	3
<i>Ragadia makuta</i>	12		2		14
<i>Rohana parisatis</i>	9		2	1	12
<i>Stibochiona coresia</i>	1				1
<i>Symbrenthia hippoclus</i>	1				1
<i>Symbrenthia hypselis</i>	2		2		4
<i>Tanaecia coccytina</i>		2	20	2	24
<i>Tanaecia godartii</i>	6			1	7
<i>Tanaecia palguna</i>				1	1
<i>Tanaecia pelela</i>	1		1	1	3
<i>Terinos clarissa</i>			2		2
<i>Terinos terpander</i>			1		1
<i>Vagrans egista</i>	3		2		5
<i>Vindula dejone</i>			1		1
<i>Xanthotaenia busiris</i>	13		1		14

Table 1 (continued)

Family and species	Number of individuals				Total
	Secondary forests	Pine forests	Rubber forests	Agricultural areas	
<i>Ypthima baldus</i>	8	24		17	49
<i>Ypthima fasciata</i>	3	2	3	3	11
<i>Ypthima pandocus</i>	10	11	12	15	48
<i>Ypthima philomela</i>		13	1	6	20
<i>Ypthima sp.</i>	3	33	18	23	77
Papilionidae					
<i>Atrophaneura nox</i>	1		2		3
<i>Graphium agamemnon</i>	5	7	4	11	27
<i>Graphium antiphates</i>	1			1	2
<i>Graphium bathycles</i>			8		8
<i>Graphium evemon</i>	2			2	4
<i>Graphium sarpedon</i>	9	20	21	36	86
<i>Lamproptera curius</i>			3		3
<i>Meandrusa payeni</i>				1	1
<i>Pachliopta aristolochiae</i>			31		31
<i>Papilio demoleus</i>		16		3	19
<i>Papilio demolion</i>		6	14		20
<i>Papilio helenus</i>	1	2	2		5
<i>Papilio memnon</i>	10	4	40	23	77
<i>Papilio nephelus</i>	4		13	3	20
<i>Papilio polytes</i>		52	30	42	124
<i>Papilio palinurus</i>		6			6
<i>Trogonoptera brookiana</i>	6		23	2	31
<i>Troides amphrysus</i>	5		5		10
<i>Troides cuneifera</i>				2	2
<i>Troides sp.</i>	23		19		42
Pieridae					
<i>Appias cardena</i>	2		1		3
<i>Appias lycinda</i>	1	22	29	4	56
<i>Appias olferna</i>		2	12	68	82
<i>Appias paulina</i>	1	1	4	1	7
<i>Catopsilia pomona</i>		2	3	14	19
<i>Catopsilia pyranthe</i>			1	10	11
<i>Catopsilia scylla</i>	1		12	20	33
<i>Cepora iudith</i>			1		1
<i>Delias hyparete</i>			1	1	2
<i>Delias pasithoe</i>	1	1			2
<i>Eurema ada</i>			4	3	7
<i>Eurema andersoni</i>			2	1	3
<i>Eurema blanda</i>	1		2	11	14
<i>Eurema hecabe</i>	2	4	18	12	36
<i>Eurema lacteola</i>	1				1
<i>Eurema sari</i>	3	2	10	11	26
<i>Eurema simulatrix</i>			3		3
<i>Eurema sp.</i>	14	17	51	56	138
<i>Gandaca harina</i>	4			3	7
<i>Hebomoia glaucippe</i>			2		2
<i>Leptosia nina</i>	3	1	21	34	59
<i>Saletara panda</i>			2		2
Riodinidae					
<i>Paralaxita damajanti</i>	1				1
<i>Stiboges nymphidia</i>	1				1
<i>Zemeros flegyas</i>	1				1
Number of individuals	452	584	1040	982	3058
Number of species	95	59	112	94	184
Shannon diversity index (H')	4.095	3.418	4.007	3.785	4.312
Pielou's evenness (E)	0.884	0.822	0.837	0.822	0.819

most frequently visited. Twenty-four species of plants were visited by one species of butterflies (Table 2). The four plant species most visited by butterflies were *Clibadium surinamensis*, *Eupatorium inulifolium*, *Stachytarpheta jamaicensis*, and *Lantana camara*.

4. Discussion

4.1. Diversity of butterflies

The number of butterfly species found in this research area was 184 species or about 20% of the approximately 900 species described in Sumatra region. One hundred thirty-two species of

Table 2. Floral characteristics of plants visited by butterfly species at Mount Sago

Nectar plants	Plant habits	Flower color	Flower type	Butterfly species visited the flowers
Acanthaceae				
<i>Asystasia gangetica</i>	Herb	White	Funnel	<i>Y. pandacus</i> , <i>J. hedonia</i> , <i>E. blanda</i> , <i>E. hecabe</i>
<i>Rostellularia sundana</i>	Herb	Purple		<i>Z. otis</i>
Amaryllidaceae				
<i>Zephyranthes carinata</i>	Herb	Pink	Funnel	<i>C. scylla</i>
Apocynaceae				
<i>Catharantus roseus</i>	Shrub	Pink	Tube	<i>P. memnon</i> , <i>P. polytes</i>
Asteraceae				
<i>Ageratum conyzoides</i>	Herb	Purple	Head	<i>Jamides</i> sp., <i>E. mulciber</i> , <i>P. demolion</i> , <i>P. polytes</i> , <i>M. peyeni</i> , <i>Eurema</i> sp.
<i>Bidens pilosa</i>	Herb	White	Composite	<i>H. bolina</i> , <i>J. atlites</i> , <i>A. olferna</i> , <i>C. scylla</i> , <i>Eurema</i> sp.
<i>Blumea chinensis</i>	Herb	Purple	Head	<i>E. sari</i>
<i>Chromolaena odorata</i>	Shrub	White	Head	<i>P. polytes</i> , <i>J. orithya</i> , <i>C. pomona</i> , <i>Eurema</i> sp.
<i>Clibadium surinamensis</i>	Shrub	White	Head	<i>Rapala</i> sp., <i>Udara</i> sp., <i>D. melanippus</i> , <i>H. bolina</i> , <i>E. camaralzemon</i> , <i>E. tulliolus</i> , <i>E. mulciber</i> , <i>P. agleoides</i> , <i>T. cocyntina</i> , <i>T. brookiana</i> , <i>A. lyncida</i> , <i>L. nina</i>
<i>Cosmos sulphureus</i>	Herb	Orange-Yellow	Composite	<i>J. atlites</i> , <i>H. bolina</i> , <i>C. scylla</i>
<i>Elephantopus mollis</i>	Herb	White	Brush	<i>J. almana</i> , <i>P. agleoides</i>
<i>Emilia sonchifolia</i>	Herb	Purple	Head	<i>D. melanippus</i> , <i>J. atlites</i>
<i>Eupatorium inulifolium</i>	Shrub	White	Head	<i>E. cnujus</i> , <i>D. bisaltide</i> , <i>E. tulliolus</i> , <i>H. bolina</i> , <i>J. atlites</i> , <i>J. hedonia</i> , <i>J. iphita</i> , <i>P. aspasia</i> , <i>Y. baldus</i> , <i>G. agamemnon</i> , <i>G. sarpedon</i> , <i>Troides</i> sp., <i>C. pomona</i> , <i>Eurema</i> sp.
<i>Makania micrantha</i>	Liana	White	Brush	<i>J. atlites</i> , <i>J. iphita</i> , <i>J. hedonia</i> , <i>Y. baldus</i> , <i>L. nina</i>
<i>Spilanthes acmella</i>	Herb	Orange	Head	<i>Y. philomela</i> , <i>C. scylla</i> , <i>E. sari</i> , <i>L. nina</i>
<i>Synedrella nodiflora</i>	Herb	Yellow	Head	<i>E. blanda</i> , <i>L. nina</i>
<i>Zinnia elegans</i>	Herb	Pink	Composite	<i>H. bolina</i>
Boraginaceae				
<i>Heliotropium indicum</i>	Shrub	White	Tube	<i>D. melanippus</i> , <i>E. radamanthus</i> , <i>E. tulliolus</i>
Caesalpiniaceae				
<i>Caesalpinia pulcherrima</i>	Shrub	Red		<i>P. memnon</i>
<i>Cassia obtusifolia</i>	Herb	Yellow		<i>C. scylla</i>
Colchicaceae				
<i>Gloriosa superba</i>	Liana	Yellow-Red		<i>P. memnon</i>
Commelinaceae				
<i>Commelina benghalensis</i>	Herb	Blue	Funnel	<i>Eurema</i> sp.
Cucurbitaceae				
<i>Momordica charantia</i>	Liana	Yellow	Dish	<i>L. nina</i>
Euphorbiaceae				
<i>Euphorbia heterophylla</i>	Herb	White	Brush	<i>A. olferna</i>
Lamiaceae				
<i>Callicarpa</i> sp.	Liana	White	Brush	<i>T. amphrysus</i>
<i>Clerodendrum paniculatum</i>	Shrub	Red	Tube	<i>P. memnon</i> , <i>P. polytes</i>
Lauraceae				
<i>Cinnamomum zeylanicum</i>	Tree	White	Dish	<i>G. sarpedon</i> , <i>Eurema</i> sp.
<i>Persea americana</i>	Tree	White	Dish	<i>H. bolina</i> , <i>J. hedonia</i>
Malvaceae				
<i>Hibiscus sabdariffa</i>	Shrub	White	Dish	<i>P. polytes</i>
<i>Melochia umbellata</i>	Tree	Pink	Dish	<i>G. agamemnon</i> , <i>G. sarpedon</i> , <i>E. simulatrix</i>
<i>Sida rhombifolia</i>	Shrub	Yellow	Dish	<i>E. sari</i> , <i>E. blanda</i>
<i>Urena lobate</i>	Shrub	Pink	Dish	<i>J. atlites</i>
Mimosaceae				
<i>Mimosa diplotricha</i>	Herb	Pink	Brush	<i>L. boeticus</i> , <i>A. hyperbius</i> , <i>J. atlites</i>
<i>Mimosa pudica</i>	Herb	Pink	Brush	<i>J. almana</i> , <i>L. boeticus</i>
Myrtaceae				
<i>Eugenia aquea</i>	Tree	White	Brush	<i>H. bolina</i> , <i>P. demolion</i>
<i>Psidium guajava</i>	Shrub	White	Brush	<i>G. agamemnon</i>
<i>Rhodomyrtus tomentosa</i>	Shrub	Pink	Brush	<i>G. sarpedon</i>
<i>Syzygium</i> sp.	Tree	Pink	Brush	<i>D. bisaltide</i> , <i>H. bolina</i>
Nyctaginaceae				
<i>Bougainvillea spectabilis</i>	Shrub	Orange	Tube	<i>P. memnon</i> , <i>P. polytes</i>
Oleaceae				
<i>Jasminum sambac</i>	Shrub	White	Tube	<i>P. polytes</i>
Orchidaceae				
<i>Spathoglottis plicata</i>	Herb	Purple		<i>P. memnon</i>
Oxalidaceae				
<i>Oxalis barrelieri</i>	Herb	Pink	Tube	<i>P. polytes</i> , <i>Eurema</i> sp.
Papilionaceae				
<i>Calliandra calothyrsus</i>	Shrub	Red	Brush	<i>Prosotas nora</i>
<i>Crotalaria mucronata</i>	Herb	Yellow	Flag	<i>Euchrysops</i> sp., <i>L. boeticus</i>
<i>Crotalaria retusa</i>	Liana	Yellow	Flag	<i>Jamides</i> sp.
<i>Desmodium heterocarpon</i>	Herb	Purple	Flag	<i>E. lacturnus</i>
<i>Hylodesmum repandum</i>	Herb	Orange	Flag	<i>P. corvus</i>
Polygalaceae				
<i>Polygala paniculata</i>	Herb	White		<i>Z. otis</i>
Rubiaceae				
<i>Creona corymbosa</i>	Tree	White	Tube	<i>G. sarpedon</i> , <i>A. perius</i>
<i>Ixora javanica</i>	Shrub	Red	Tube	<i>P. demolion</i> , <i>P. helenus</i> , <i>P. memnon</i> , <i>P. nephelus</i> , <i>P. polytes</i> , <i>T. amphrysus</i>

(continued on next page)

Table 2 (continued)

Nectar plants	Plant habits	Flower color	Flower type	Butterfly species visited the flowers
Solanaceae				
<i>Solanum torvum</i>	Shrub	White	Dish	<i>G. sarpedon</i>
Tiliaceae				
<i>Muntingia calabura</i>	Tree	White	Dish	<i>G. sarpedon</i>
Verbenaceae				
<i>Duranta erecta</i>	Shrub	Purple	Tube	<i>C. scylla</i> , <i>L. nina</i>
<i>Lantana camara</i>	Shrub	Red-Orange, Pink-Yellow	Tube	<i>Euploea</i> sp., <i>G. agamemnon</i> , <i>G. antiphates</i> , <i>G. sarpedon</i> , <i>Troides</i> sp., <i>C. Scylla</i> , <i>Eurema</i> sp., <i>A. lycinda</i>
<i>Melastoma malabathricum</i>	Shrub	Purple	Dish	<i>G. sarpedon</i> , <i>P. nephelus</i>
<i>Stachytarpheta jamaicensis</i>		White-Purple	Tube	<i>H. bolina</i> , <i>L. boeticus</i> , <i>A. terpsicore</i> , <i>A. hyperbius</i> , <i>J. almana</i> , <i>J. atlites</i> , <i>J. hedonia</i> , <i>G. sarpedon</i> , <i>P. demolion</i> , <i>P. polytes</i> , <i>C. pomona</i> , <i>C. scylla</i> , <i>L. nina</i> , <i>E. sari</i> , <i>Eurema</i> sp.

butterflies found in this study have not been reported from recent studies in Sumatra (Rizal 2007; Sutra et al. 2012; Rahayu and Basukiriadi 2012).

The number of butterfly species recorded from this study was relatively high, compared to number of species recorded from other areas in Sumatra. For example, there were 27 species in Rimbo Panti Nature Reserve, 15 species in Lubuk Minturun recreation area (Rizal 2007), 43 species in Urban forest of Muhammad Sabki Jambi (Rahayu and Basukiriadi 2012), and 42 species in Tanjung Balai Karimun, Riau islands (Sutra et al. 2012). The number of butterfly species recorded in Mount Sago was also higher than butterfly species recorded in other islands in Indonesia, i.e. 113 species at Minyambou, Papua (Panjaitan 2008), 28 species in Bunaken National Park, Manado (Koneri and Saroyo 2012), 151 species at Gunung Halimun-Salak National Park (Peggie and Harmonis 2014). The different number of butterfly species found was related to different size of the area and sampling efforts. It might also be due to differences in environmental conditions (Ramos 2000).

Species diversity and abundance of butterfly at four study sites varied. The highest diversity of butterfly in secondary forest was related to the highest evenness in this area. Meanwhile, pine forest and agricultural area had low evenness due to the occurrence of some dominant species, such as *Papilio polytes*, *Danaus melanippus*, and *Everes lacturnus* in pine forest; and *Neptis hylas* and *Appias olferna* in agricultural area. Composition of the butterfly species was related to vegetation structure (Ramos 2000). High numbers of butterfly species were found in rubber forest perhaps because of availability of food resources, such as *Clibadium surinamensis* and *Lantana camara*. Koneri and Saroyo (2012) reported that habitat with shrub vegetation had high richness and abundance of butterflies. We supposed that higher species number of butterfly found in rubber forest and agricultural area were related with butterfly diversity in secondary forest. Meanwhile, the lower diversity in pine forests might be caused by its homogenous vegetation and location of this habitat that was separated from the natural forest.

Nymphalid butterflies were dominant among the other families. This family of butterfly was also reported dominant in several areas (Panjaitan 2008; Nimbalkar et al. 2011), commonly found in the road, edges, and intermediate disturbed areas (Ramos 2000).

Meanwhile, Riodinid butterfly family was rarely observed, only three individuals from three species. This family was found almost exclusively in neotropical areas. In Indonesia, there are 40 species of Riodinid butterflies and approximately 16 species were found in Sumatra (unpublished data). Three butterfly species found are listed in Appendix II of CITES, i.e. *Trogonoptera brookiana*, *Troides amphrysus*, and *Troides cuneifera* (Figure 1). Two species of them are protected in Indonesia (PP 7 & 8 Year 1999 and UU No. 5 Year 1990), i.e. *T. brookiana* and *T. amphrysus* (Peggie 2011).

4.2. Flower preference of butterflies

Butterflies visited wide variety of flower plants and had preference regarding of nectar source. Lycaenid butterfly visited herb with a flag shape most frequently. All plants of Papilionaceae/Fabaceae family observed in this study were visited by lycaenid butterflies. In western Poland, out of 25 plants species visited by lycaenid butterflies, the most frequently visited plants were Fabaceae family (73%), and there was definite preference for yellow and violet color (Bakowski and Baron 2005). Papilionid butterflies generally visited shrub flowers with a crown shaped tube, such as *Ixora javanica* (Rubiaceae) and *Lantana camara* (Verbenaceae). The choice of plants as nectar sources by butterflies was correlated with characteristics of flower. Marginal length of corolla depths generally limited the exploitation of nectar by a butterfly in relation to proboscis length (Tiple et al. 2009; Duara and Kalita 2014). Visitation preferences of butterflies were also reported in relation to concentration and composition of nectar (Pivnick and Neil 1985, Boggs 1988), color (Duara and Kalita 2014), and odor (Sourakov et al. 2012).

The butterflies in Mount Sago were found in high species number, but some species had lower abundance (48 species of butterfly consisted of only one individual). These data should be concerned by local peoples and related institutions before these species become extinct. Restoration of habitats by increasing food plants for butterflies will support their survival. Mount Sago has high biodiversity, and therefore should be determined as conservation area with better management. Many ecological aspects of butterflies in this area should be explored, including monitoring of

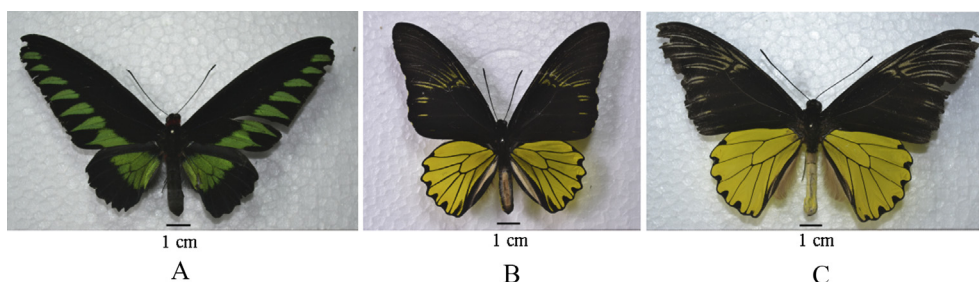


Figure 1. Butterflies found in this study and are listed in Appendix II of CITES: (A) *Trogonoptera brookiana*, (B) *Troides amphrysus*, and (C) *Troides cuneifera*.

the species and their life cycles, especially butterflies species listed in appendix II of CITES.

Conflict of interest

There are no conflict of interest.

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